

## 7 The Laws of Motion

Worksheet B: Multiple-Force Problems

Name \_\_\_\_\_

Inquiry Physics

**Work these problems on a separate sheet of paper. For each problem, include a free-body diagram of the primary object being accelerated. Show ALL work, including equations, units, and boxed answers. Note that some answers are given so that you can check your progress.**

1. A 20.0 kg crate hangs at the end of a long rope. Find the size and direction of its acceleration when the tension in the rope is...

a) 250 N

*Answer: 2.70 m/s<sup>2</sup> up*

Now find the size and direction of its acceleration when the tension is...

b) 150 N

2. In a modified tug-of-war game, two people pull in opposite directions, not on a rope, but on a 25.0 kg sled resting on an icy road. If the participants exert forces of 90.0 N and 92.0 N, how much will the sled accelerate?

3. Compute the size of the initial upward acceleration of a rocket of mass  $1.30 \times 10^4$  kg if the initial upward thrust of its engine is  $2.60 \times 10^5$  N. Do not neglect the weight of the rocket.

4. A 160 lb firefighter slides down a vertical pole with an acceleration of  $10.0 \text{ ft/s}^2$ , directed downward.

a) How much upward vertical force does the pole exert on the firefighter?

(You will need to find the mass of the firefighter in slugs, using  $F_g = mg$  with  $g = 32.2 \text{ ft/s}^2$ .)

*Answer: 110 lb*

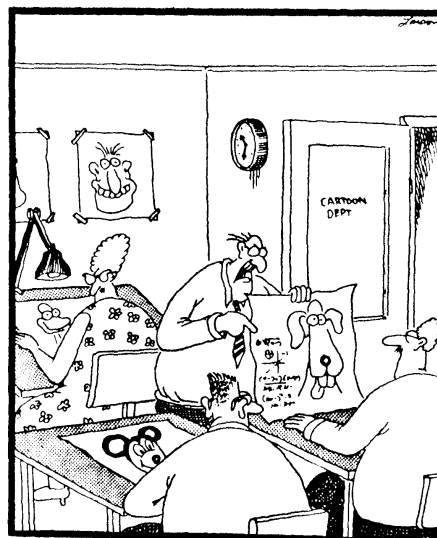
b) How much force is exerted on the pole by the firefighter? Indicate which law of motion yields the answer.

5. A 60.0 kg woman stands in an elevator that is accelerating downward at  $3.10 \text{ m/s}^2$ .

a) What is the size and direction of the normal force acting on her?

*Answer: 402 N upward*

b) What is the amount of her force against the floor? Indicate the law of motion you use.



"Hey! What's this, Higgins? Physics equations? ... Do you enjoy your job here as a cartoonist, Higgins?"



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